

attainment of the desired cleanup levels, but may take longer to meet them than active remediation. This approach is most likely to be appropriate where the affected ground water is not a current or reasonably expected future source of drinking water, and ground-water discharge does not significantly impact surface water or ecologic resources. Sufficient technical information and supporting data must be presented to demonstrate the effectiveness of this strategy, along with assurances that any institutional controls required to prevent exposure will be reliable and enforceable. Contingencies for additional or more active remediation also should be incorporated into the remedy, to be triggered by specific contaminant concentration levels in the site ground-water monitoring network, or other criteria as appropriate.

5.2 Alternative Remedy Selection

The alternative remedial strategy options discussed above represent a range of responses for addressing the various aspects of a ground-water contamination site. Selection of the options appropriate for a particular site must not only consider the desired remediation objectives, as discussed above, but also the statutory and regulatory requirements applicable to the program under which the action is being taken. These requirements are discussed briefly below. Further information and guidance on these requirements can be obtained from publications referenced in this section.

5.2.1. Superfund

The selection of an alternative remedy at a Superfund site should follow the remedy selection process provided in NCP §300.430(f). Regardless of whether ARARs are waived at the site, the alternative remedy still must satisfy the two threshold remedy selection criteria (protect human health and the environment and comply with all ARARs that have not been waived); be cost effective; and utilize permanent solutions and treatment to the maximum extent practicable. This last finding is satisfied by identifying the alternative that best balances the trade-offs with respect to the remaining balancing and modifying criteria, taking into account the demonstrated technical limitations (see Highlight 2).²⁰

Where ground-water ARARs are waived at a Superfund site due to technical impracticability, EPA's

general expectations are to prevent further migration of the contaminated ground-water plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction measures as appropriate. (NCP §300.430(a)(1)(iii)(F)). These expectations should be evaluated along with the nine remedy selection criteria to determine the most appropriate remedial strategy for the site.

Highlight 2. Superfund Remedy Selection Criteria

Threshold Criteria

- Overall protection of human health and the environment
- Compliance with (or justification for a waiver of) ARARs

Balancing Criteria

- Long-term effectiveness and permanence
- Reduction of mobility, toxicity, or volume
- Short-term effectiveness
- Implementability
- Cost

Modifying Criteria

- State acceptance
- Community acceptance

5.2.2 RCRA

At RCRA facilities where ground-water restoration is technically impracticable, the permit or order schedule of compliance may be modified by establishing: 1) further measures that may be required of the permittee to control exposure to residual contamination, as necessary to protect human health and the environment; and 2) alternate levels or measures for cleaning up contaminated media.²¹

Criteria for establishing an alternative remedial strategy under RCRA are presented in Highlight 3. In addition to satisfying the general standards for remedies, the alternative remedial strategy at a RCRA facility also should provide the best balance of trade-offs among the five remedy selection decision factors.²²

20 For further guidance on the Superfund remedy selection process, see NCP §300.430(f) and "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA," (EPA 1988a).

21 Proposed Subpart S Rule, §264.531(b).

22 Further guidance on remedy selection at RCRA facilities is provided in the proposed Subpart S Rule (55 FR 30823-30824, July 27, 1990).

**Highlight 3.
RCRA Remedy Standards and
Selection Factors**

General Standards for Remedies

1. Overall protection of human health and the environment
2. Attainment of media cleanup standards
3. Source control
4. Compliance with waste management standards

Remedy Selection Decision Factors

1. Long-term effectiveness
2. Reduction of waste toxicity, mobility, or volume
3. Short-term effectiveness
4. Implementability
5. Cost

**5.2.3 Additional Remedy Selection
Considerations**

The choice among available remedial strategy options may involve a consideration of the aggressiveness of the remedy, a concept that includes both the choice of remedial technologies as well as the relative intensity of how that technology is applied at the site. For example, consider a site where source area restoration is technically impracticable but source containment is both feasible and practicable. With the contaminant source contained, restoration of the portion of the plume outside of the containment area may be feasible. However, as discussed earlier, there are several options for attaining cleanup levels within the aqueous plume: active pump-and-treat throughout the aqueous plume; natural gradient flushing of the plume towards a pump-and-treat capture system located at the leading edge of the plume; and natural attenuation (dilution, dispersion, and any natural degradation processes active within the affected aquifer). Each alternative will attain the required cleanup levels, but the choice involves a trade-off among several factors, including: 1) remediation timeframe (longer with less aggressive strategies); 2) cost (lower with less aggressive strategies); and 3) potential risk of exposure (may increase with less aggressive strategies).²³

Conditions favoring more aggressive strategies (i.e., active pump-and-treat throughout the aqueous plume) include the following:

1) **The aggressive strategy clearly will result in a significantly shorter restoration timeframe than other available options.** This will depend on site hydrogeologic and contaminant-related factors, including the complexity of the aquifer system, natural rate of ground-water flow, quantity of sorbed contaminant mass in the aquifer (and its rate of desorption), and other factors.

2) **A shorter remediation timeframe is desired to reduce the potential for human exposure.** This generally is the case where there is current or reasonably expected near-term future use of the ground water. Factors that may be useful in evaluating the likelihood of exposure include the State (or Federal, as appropriate) classification of the ground water; availability of alternate supplies, such as municipal hook-ups or other water supply aquifers; interconnections of the contaminated aquifer with other surface or ground waters; and the ability of institutional controls to limit exposure.

3) **A shorter remediation timeframe is desired to reduce ongoing or potential impacts to environmental receptors.** Such impacts may be caused by discharges to surface waters, sensitive ecologic areas (e.g., wetlands), or sole-source aquifers.

EPA will evaluate and determine the objectives and relative aggressiveness of the alternative remedy on a site-specific basis, based on the applicable regulatory requirements and considering the factors discussed throughout this section. Where conditions favoring more aggressive strategies do not exist, EPA is more likely to choose a less aggressive strategy to achieve the desired remediation objectives. EPA recognizes that, at some sites, remedies may need to be in operation for very long time periods. Adequate monitoring and periodic evaluation of remedy performance should be conducted to ensure protectiveness and to evaluate the need for remedy enhancements or the use of new or different remediation technologies.

**5.2.4 Relation to Alternate Concentration
Limits**

Site-specific cleanup levels established as part of an alternative remedial strategy at a Superfund site should not be confused with CERCLA Alternate Concentration Limits (ACLs). To qualify for use of a CERCLA ACL, the site must meet the following three requirements: 1) there are known points of entry of the contaminated ground water into surface water; 2) there

²³ The long-term reliability of a remedy also is an important consideration for alternative remedial strategy selection. In this example, long-term reliability is primarily a function of the design and integrity of the source containment system.

will be no statistically significant increases of the contaminant concentrations in the surface water or contaminant accumulations in downstream sediments; and 3) enforceable measures can be put into place to prevent exposure to the contaminated ground water (see CERCLA §121(d)(2)(B)(ii)). In addition, EPA generally considers ACLs appropriate only where cleanup to ARARs is impracticable, based on an analysis using the Superfund remedy selection "balancing" and "modifying" criteria shown in Highlight 2. Where an ACL is established, an ARAR waiver is not necessary. Conversely, where an ARAR is waived due to technical impracticability, there is no need to establish a CERCLA ACL. For further guidance on CERCLA ACLs, refer to the NCP Preamble (55 FR 8754, March 1990).

Site-specific cleanup levels established in response to a TI determination at a RCRA facility also should not be confused with ACLs established as part of the ground-water monitoring program for regulated units under 40 CFR 264.94. ACLs established under §264.94(a)(3) represent concentrations that EPA determines will not pose a substantial hazard to human or environmental receptors. (If the ACL is exceeded, then corrective action responsibilities for the regulated unit are triggered.) A TI determination generally will not satisfy the criteria for an ACL under this authority.

6.0 Administrative Issues

6.1 TI Review and Decision Process

A TI decision must be incorporated into a site decision document (Superfund ROD or RCRA permit or enforcement order) or be incorporated into a modification or amendment to an original document. Information and analyses supporting the TI decision must be incorporated into the site administrative record, either as part of a Feasibility Study or Corrective Measures Study (for a "front-end" TI determination) or remedy performance evaluation or other technical report or evaluation (for a post-remedy implementation determination).

The first step in EPA's review process for a TI determination will be to assess the completeness and adequacy of the TI evaluation. TI evaluations that do not adequately address the considerations identified in this

guidance likely will have to be revised or augmented to address the inadequacies identified by EPA or the responsible agency. Early consultation with EPA by PRPs or owner/operators is encouraged to help identify appropriate data and analysis for the evaluation. While a TI evaluation is underway, remediation efforts underway at a site shall continue until the State or Federal official responsible for the decision determines that the existing remedy should be altered. Requirements specific to the Superfund and RCRA programs are discussed further below.

6.1.1 Superfund

As discussed in Section 4.2, TI decisions may be made either in the ROD (front-end decisions) or after the remedy has been implemented and monitored (post-implementation decisions), depending on the circumstances of the site.

TI decisions at Superfund sites generally will be made by the EPA Regional Administrator who, upon review of a TI evaluation, will determine whether ground-water restoration is technically impracticable and will identify further remedial actions to be taken at the site. TI determinations at Superfund sites may require consultation with headquarters program management. Regional personnel should refer to the most recent OERR Remedy Delegation Memorandum for current consultation requirements.²⁴

Where a Superfund ROD will invoke a TI ARAR waiver (front-end decision), EPA (or the lead agency) must provide notice of its intent to waive the ARAR in the Proposed Plan for the site and respond to any State (or Federal) agency or public comments concerning the waiver. The requirements for State and community involvement are provided in NCP §300.500-515 and §300.430, respectively. In general, State and community involvement in the decision to waive an ARAR based on technical impracticability will be the same as for other site remedy decisions. Since TI decisions may affect the potential future uses of ground water, interest in TI ARAR waivers may be high. Therefore, it is EPA's intent to coordinate and consult with States and the public regarding TI ARAR waiver issues as early as possible in the remedy decision process.

²⁴ The types of Superfund site remedy decisions that require consultation with headquarters program management are identified in the periodically updated OERR Remedy Delegation Memorandum. The most recent version available at the time of publication of this guidance was the "Twenty Fourth Remedy Delegation Report - FY 1993," dated February 18, 1993.

State concurrence should be sought, but is not required, for all remedy decisions in which EPA invokes an ARAR waiver. Where the ARAR to be waived is a State ARAR, EPA must notify the State of this when submitting the RI/FS to the State or when responding to a State-lead RI/FS (NCP §300.515(d)(3)). EPA must provide the State with an explanation of any waiver of a State standard (CERCLA §121(f)(1)(G)).

For remedial actions under CERCLA §106 that will waive an ARAR, the State must be notified at least 30 days prior to the date on which any Consent Decree will be entered. If the State wishes the action to conform to (and not waive) those standards, the State may intervene in the action before the Consent Decree is entered (see §121(f)(2) and (f)(3)).

At certain State-lead sites, the State may make the final remedy decision, including a decision to invoke an ARAR waiver. This situation is restricted to sites where the State has been assigned the lead role for the response action, the action is being taken under State law, and the State is not receiving funding for the action from the Trust Fund. In such situations, the State may seek, but is not required to obtain, EPA concurrence on the remedy decision. For further guidance on this and other issues regarding the State role in remedy selection, see "Questions and Answers About the State Role in Remedy Selection at Non-Fund-Financed Enforcement Sites" (EPA 1991c).

Post-remedy-implementation TI decisions may be made in cases where an outside party or agency submits comments requesting a TI determination or EPA determines on its own initiative that a waiver is warranted. The information considered in making such decisions should include the same types of information and analyses discussed for front-end determinations, except that remedy performance data and analysis also should be provided. This information must be entered into the site administrative record before the TI decision can be made and an ARAR waiver invoked. There are limitations, however, to the requirement that EPA open the administrative record to new comments, such as an outside party's request for a TI determination. EPA is not required to consider comments on the selected remedy unless the comments contain "significant information not contained elsewhere in the administrative record file

which substantially supports the need to significantly alter the response action" (see NCP §300.825). The type and amount of information necessary to meet this requirement (e.g., the length of time a remedy must be operated prior to a TI evaluation) will be determined by EPA on a site-specific basis.

A modification to a signed ROD invoking a TI ARAR waiver generally will require a ROD amendment, since a waiver usually will constitute a fundamental change in the remedy. A public comment period of 30 days is required for an amendment to a ROD; this period may be extended to 60 days upon request.²⁵ A public meeting also should be granted if requested. In the exceptional case where an ESD is used to invoke a TI ARAR waiver, public notice and opportunity for comment also should be provided. Further guidance on ROD amendments is provided in "Guide to Addressing Pre-ROD and Post-ROD Changes" (EPA 1991b) and upcoming revisions to "Guidance on Preparing Superfund Decision Documents" (expected Fall 1993).

6.1.2 RCRA

TI decisions at RCRA Corrective Action facilities will be made either by the EPA Regional Administrator or by the appropriate State agency, depending on the RCRA program authorization status of the State. EPA's goal in the RCRA corrective action program is to work cooperatively with individual States, regardless of their authorization status, to promote consistent TI decisions. As in the Superfund program, it is recommended that the State and EPA notify and consult each other as early as possible regarding sites where TI determinations may be made. This notification and consultation process may be outlined in the State/EPA Memorandum of Understanding.

For States authorized for Hazardous and Solid Waste Amendments (HSWA) Corrective Action, the State will have primary authority for remedy decisions, including TI decisions. EPA will retain authority for TI determinations in States that are not authorized for HSWA corrective action.

At RCRA permitted facilities, implementation of a TI determination generally would require a Class 3 permit modification for the purpose of specifying (alternative) corrective measures. This process requires a 45-day notice and comment period, response to comments, and

²⁵ Public notice and opportunity for comment should be provided before an ARAR waiver is granted, regardless of whether an Explanation of Significant Differences (ESD) or ROD amendment is used to invoke the waiver.

public hearing, if requested. At RCRA facilities conducting corrective action under an order, TI determinations generally are implemented through the negotiation of a new order or an amendment to an existing order. This process generally includes a 30- to 45-day public comment period and public hearing, if requested.

6.1.3 Technical Review and Support

Technical support for the TI evaluation should be sought as early in the process as possible, preferably during the initial scoping of the content of the TI evaluation. TI determinations usually will require expertise from several disciplines, including hydrogeology, engineering, and risk assessment. Technical staff within the Regions representing these disciplines should be part of the TI review team. EPA's Office of Research and Development (ORD) technical liaisons and scientists based in the Regions also may provide assistance to program staff. Further assistance and review may be obtained from the ORD laboratories involved in the Technical Support Project, including the R.S. Kerr Environmental Research Laboratory (Ada, OK), the Risk Reduction and Engineering Laboratory (Cincinnati, OH), the Environmental Research Laboratory (Athens, GA), and the Environmental Monitoring Systems Laboratory (Las Vegas, NV). The directory of ORD technical services may be consulted for further information (EPA 1993c).

General assistance and site-specific consultation on technical impracticability issues also is available from EPA headquarters staff. Inquiries should be directed to the appropriate OSWER program office.

6.2 Duration of TI Decisions

A determination that ground-water restoration is technically impracticable and the subsequent selection of an alternative remedial strategy will be subject to future review by EPA.

At Superfund sites, an alternative remedial strategy implemented under a CERCLA TI waiver remains in effect so long as that strategy remains protective of human health and the environment. Protectiveness in this context encompasses long-term reliability of the remedy. If the conditions of protectiveness or reliability conditions cease to be met, EPA will determine

what additional remedial actions must be implemented to enhance or augment the existing remedy. EPA shall conduct a full assessment of the protectiveness of the alternative remedy at least every five years at any site where contamination remains above levels that allow for unrestricted use, as required under NCP §300.430(f)(4)(ii).

RCRA TI decisions will be incorporated into facility permits or enforcement orders and therefore will be subject to continual oversight and review. Conditions of the permit or order involving the TI decision or the alternative strategy may be revisited on a periodic basis to ensure protectiveness. It may be necessary to modify permits or orders to reflect new information that becomes available during the remedy implementation and monitoring period.²⁶ Additional measures may be required by EPA to ensure the ongoing protectiveness and reliability of the remedy. Further, owner/operators of RCRA facilities may be required by EPA to undertake additional remedial measures in the future if subsequent advances in remediation technology make attainment of media cleanup standards technically practicable.

The protectiveness of an alternative remedial strategy at a Superfund site or RCRA facility must be ensured through a monitoring program designed to detect releases from containment areas, migration of contaminants to water supply wells, or other releases that would indicate a possible failure of one of the remedy components. EPA may decide to take any further response actions necessary to ensure protectiveness at any time based upon whether the alternative remedy is achieving its required performance standards. Monitoring data, therefore, must be provided to EPA on a regular basis to ensure adequate performance of the alternative remedy. The format, content, and reporting schedule of the monitoring program will be determined by EPA as part of the TI determination and alternative remedy selection process.

²⁶ RCRA Corrective Action Orders that incorporate TI decisions should contain language that retains EPA's authority to review these decisions and complete additional site remediation, as necessary.

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